1st, 1848, he found the temperature to be only 104° F.* These remarkable fluctuations in the temperature of Síta-kund are well deserving of further inquiry, and Síta-kund is so accessible to residents at Mungir that frequent thermometric observations could readily be carried out there. Several irregular observations by Mr. Masters on the hot springs of the Námba forest in Assam† also indicated considerable fluctuations in the temperature of those springs at different seasons.

The springs above described, together with some others already published, form two well-marked chains running parallel to one another in a direction from S. W. to N. E.—the one series being found along the southern flank of the Santal Pargana Hills, and the other about 95 miles further north, in the Kharagpur Hills and chiefly along their southern flank. It is interesting to find historic testimony to the former existence in this latter region of an active volcano: the Chinese pilgrim, Hiuen Tsiang who visited the neighbourhood of Mungir about "the year 634 A. D. records‡ that "by the side of the capital and bor-"dering on the Ganges river is the I-lan-no mountain, from which is "belched forth masses of smoke and vapour which obscure the light of "the sun and moon."

XIII.—*Natural History Notes from H. M.'s Indian Marine Survey Steamer* "Investigator," *Commander* R. F. Hoskyn, R. N., *Commanding—No.* 16. *The non-indigenous species of the Andaman Flora.—By* D. Prain.

[Received 28th February 1890; Read 2nd April 1890.]

The non-indigenous element in a flora—the weeds of cultivation and the cultivated plants—species introduced, involuntarily or intentionally, by man—is not often dealt with apart, since weeds are rarely in themselves interesting, and because a local treatment is hardly satisfactory where cultivated forms are concerned. But the intrusion of this element is a subject of peculiar interest, particularly when it is possible to review it historically, and as opportunities for doing this are rare, it is well to make use of all that occur.

The Indian convict settlement of Port Blair in the Andaman islands affords such an opportunity. This settlement was commenced

* *Himalayan Journals*, I, p. 89.

† Reported by Dr. Prain in the Society's *Proceedings* for 1887, p. 201.

‡ *Si-yu-ki*, translation from the Chinese of Hiuen Tsiang by S. Beal, II, p. 187.

in its present form in 1858, but it occupies the site of a settlement that existed for a few years in the end of the 18th century, so that some common weeds may possibly have been already introduced and established when the present colony was founded. This prevents us from going back without question to the year 1858 as a starting-point in our enquiry; but, while we are unable to do this, we have nevertheless a quite satisfactory date of commencement in the year 1866, for in that year the late Mr. S. Kurz* paid a botanical visit to the Andamans the results of which are enbodied in a *Report on the Vegetation of the Andaman Islands.*† As an *Appendix* to this report (pp. 29—59) an *Enumeration of the Plants on the Andaman Islands* is given; in this enumeration and in a tabular *Recapitulation* (pp. 22, 23) Mr. Kurz has distinguished the non-indigenous element and dealt separately with its items. The treatment cannot be better explained than it is by Mr. Kurz himself in the following passage taken from his Report (p. 24) :—

"A considerable number of plants on the Andamans are only introduced, though some of these species in the surrounding countries "are without any hesitation enumerated in their floras as indigenous. "I noted not less than 76 of these introduced species, while in Singapore the numbers are only 31. This great difference, however, is "scarcely a real one, as we can be certain that most plants at the latter "place are introduced only when they are known to be non-Indian "forms.

"The introduced herbaceous plants on the Andamans are 74 in "number; thus being in proportion to the woody plants as 37 : 1. Of "these, seven only are American; which are, therefore, surpassed in "number by nine times the introduced species from the old Continent. "As regards dissemination, the American species supersede the old "Asiatic forms (except grasses), however, in number of individuals.

"An enquiry into the causes of the different modes of immigration "of the non-indigenous plants on the Andamans would show that the "whole number has been introduced by the agency of man, direct and "indirect—a fact which also proves how little chance there is for exotic "plants to cross the sea. I am inclined also to believe that introduction "by means of winds, birds, &c., is applicable only to continents and "adjacent islands, but not to isolated groups of islands. The Andamans "will become an instructive spot for inquiries into the change of a flora

* Wilhelm Sulpiz Kurz, native of Augsburg, Curator of the Herbarium of the Royal Botanic Garden, Calcutta, from 1863 till his death in 1878.

† Calcutta; Office of Superintendent of Government Printing, Ed. 2, 1870: [the first issue, a purely official document of which the edition quoted is a reprint, was circulated by the Government of India in 1867.]

"by introductions. As I directed my full attention to herbaceous "plants, I hope that I have noted nearly all the plants growing at my "visit in the cleared lands."

During a brief visit to the Andamans, in November 1889, the writer made as complete a collection as the time at his disposal would permit of the naturalised species in the settlement at Port Blair, in order to ascertain the number and nature of the species introduced between 1866 and 1889. And Dr. King, who paid a short visit to the settlement in April 1890, very kindly collected such weeds as were flowering then, but had not been seen in the previous November. The results of the visits are given below, the plants collected first by Dr. King being indicated by a (K); the following method has been adopted in presenting them:—

1. Cultivated species and weeds—enumerated together by Mr. Kurz—are here dealt with separately.

2. Species (of both kinds) present in 1866 are taken from the *Enumeration* by Mr. Kurz referred to above; for convenience of reference the synonymy of the *Report* has been made to conform with the nomenclature in the *Flora of British India.**

3. Additional species (of both kinds) are those first met with by the writer in 1889, or by Dr. King in 1890.

It ought to be noted that the list of cultivated species for 1866, as the remarks of Mr. Kurz shew, is not exhaustive. This is equally true of the corresponding list for 1890. It has been felt that an exhaustive list of exotic species could serve no useful purpose; it is sufficient if attention be directed to such plants, introduced since 1866, as may be reasonably supposed to be capable of becoming in the course of time spontaneous or subspontaneous, and to such plants as possess a direct economic interest. The remarks attributed to Mr. Kurz are in every case taken *verbatim* from his report; where necessary the condition of the species in 1889-90 is commented on; when no second remark occurs the condition of the species is to be understood as having remained apparently unchanged during the period between 1866 and 1890.

* This it has been possible to do with certainty since the original specimens on which Mr. Kurz' *Report* is based are preserved in the Calcutta Herbarium and have in every case been re-examined by the writer.

## A. Species under cultivation, obviously planted or intentionally introduced.

### I. *Species under cultivation or obviously planted in* 1866.

| | Name of Species. | Remarks. | |
|---|---|---|---|
| | | Condition in 1866 (*Kurz*). | Condition in 1889-90. |
| | Michelia Champaca *Linn.* | 'Cultivated in gardens at Port Blair.' | |
| | Cananga odorata *H. F. & T.* | 'Cultivated only in the gardens.' | |
| | Anona squamosa *Linn.* | 'Cultivated only in gardens.' | |
| | *Brassica oleracea *Linn.* | 'Many varieties of this plant are cultivated, but do not grow well owing to the great moisture of the atmosphere.' | |
| 5 | *B. campestris *Linn.* | 'As the former.' | |
| | *Raphanus sativus *Linn.* | 'Cultivated only.' | |
| | Bixa Orellana *Linn.* | 'Cultivated only.' | Cultivated and appearing spontaneously in waste places. |
| | Hibiscus rosa sinensis *Linn.* | 'Cultivated only.' | |
| | Gossypium barbadense *Linn.* var. acuminatum. | 'Cultivated only.' | Cultivated and (as on Mt. Harriet) appearing spontaneously in waste places. |
| 10 | Impatiens Balsamina *Linn.* | 'Cultivated in gardens, and sometimes spontaneously.' | |
| | Citrus medica *Linn.* | 'Cultivated in the gardens of Europeans.' | |
| | C. decumana *Linn.* | [Cultivated in the gardens of Europeans]. | |
| | Mangifera indica *Linn.* | 'Cultivated.' | Not very successfully. |
| | Moringa pterygosperma *Gaertn.* | 'A couple of trees observed on Viper island evidently planted.' | Very common everywhere throughout the Settlement. |
| 15 | *Lupinus, sp. | 'Cultivated in gardens.' | Not seen in 1889 or 1890. |
| | Sesbania grandiflora *Pers.* | 'Cultivated at Hopetown, Ross Island, etc.' | |
| | *Cicer arietinum *Linn* | 'Cultivated only.' | |
| | *Pisum sativum *Linn.* | 'Cultivated only.' | |
| | Clitoria Ternatea *Linn.* | 'Cultivated and sometimes as wild.' | |
| 20 | Canavalia ensiformis *DC.* | 'Cultivated only.' | Mr. Kurz refers to the form distinguished as *C. gladiata* by M. DeCandolle. The wild form of the plant is indigenous. |

| | Name of Species. | Remarks. | |
|---|---|---|---|
| | | Condition in 1866 (*Kurz*). | Condition in 1889-90. |
| | Phaseolus, several species. | 'Cultivated only in gardens.' | *P. lunatus*, *P. vulgaris* and *P. Mungo*. |
| | Vigna Catjang *Endl.* | 'Much cultivated by native convicts.' | |
| 25 | Pachyrhizus angulatus *Rich.* | 'Cultivated.' | |
| | Dolichos Lablab *Linn.* | 'Cultivated only.' | |
| | Cajanus indicus *Spreng.* | 'Cultivated and sometimes wild.' | In many places subspontaneous or spontaneous. |
| | Caesalpinia pulcherrima *Sw.* | 'Only cultivated.' | |
| | Cassia Fistula *Linn.* | 'Cultivated in gardens at Ross Island.' | |
| 30 | Acacia Farnesiana *Willd.* | 'Much cultivated on Ross Island.' | |
| | Leucæna glauca *Benth.* | 'Cultivated on Ross Island.' | |
| | *Rosa, several species. | 'Cultivated in gardens.' | |
| | *Quisqualis indica *Linn.* | 'In gardens of Europeans, cultivated.' | |
| | Psidium Guyava *Linn.* | 'Cultivated only.' | A good deal planted on Mt. Harriet. |
| 35 | *Cuphea, sp. | 'Observed occasionally in the gardens of Europeans.' | Not seen in 1889. |
| | Lawsonia alba *Lamk.* | 'Only cultivated.' | Used as a hedge at Aberdeen. |
| | Punica Granatum *Linn.* | 'Cultivated only.' | |
| | *Passiflora laurifolia *Linn.* | 'Cultivated in gardens of Europeans.' | |
| | Carica Papaya *Linn.* | 'Cultivated and spontaneously springing up around Port Blair.' | Now very common along the sides of jungle paths and spreading along the coast within the line of shore vegetation. |
| 40 | Trichosanthes cucumerina *Linn.* | 'Cultivated.' | Commonly spontaneous. |
| | T. anguina *Linn.* | 'Cultivated.' | Only in cultivation. |
| | Lagenaria vulgaris *Ser.* | 'Cultivated.' | |
| | Luffa aegyptiaca *Mill.* | 'Cultivated.' | Cultivated and also as an escape. |
| | Benincasia cerifera *Savi.* | 'Cultivated.' | |
| 45 | Momordica Charantia *Linn.* | 'Cultivated.' | |
| | M. dioica *Roxb.* | 'Cultivated.' | |
| | Cucumis Melo *Linn.* | 'Cultivated.' | |
| | C. sativus *Linn.* | 'Cultivated.' | |
| | Citrullus vulgaris, *Schrad.* | 'Cultivated.' | |

| | Names of Species. | Remarks. | |
|---|---|---|---|
| | | Condition in 1866 (*Kurz.*) | Condition in 1889-90. |
| 50 | Cucurbita maxima *Duchesne.* | 'Cultivated.' | |
| | *Opuntia, *Cereus, *Melocactus, *Epiphyllum, *Echinocactus (Several species.) | 'In the gardens of Europeans.' | |
| 55 | *Carum Roxburghianum *Benth.* | 'Cultivated.' | |
| | *Peucedanum graveolens *Benth.* | 'Cultivated.' | |
| | *Coriandrum sativum *Linn.* | 'Cultivated.' | |
| | *Cuminum Cyminum *Linn.* | 'Cultivated.' | |
| 60 | *Rondeletia speciosa *Lodd.* | 'Cultivated in gardens.' | |
| | *Pentas carnea *Benth.* | 'Cultivated in gardens.' | |
| | Zinnia, several species. | 'Cultivated in gardens.' | Frequently subspontaneous. |
| | *Rudbeckia, species. | 'Cultivated in gardens.' | |
| | *Coreopsis, several species. | [Cultivated in gardens.] | |
| 65 | Tagetes, several species. | [Cultivated in gardens.] | Also in waste places near the houses of 'self-supporter' convict colonists, common. |
| | Plumbago rosea *Linn.* | 'Cultivated in gardens.' | |
| | Jasminum, several sp. | 'Cultivated in the gardens of Europeans.' | |
| | Allamanda cathartica *Linn.* | 'Cultivated in gardens.' | |
| | Thevetia neriifolia *Juss.* | 'Cultivated in gardens.' | |
| 70 | Vinca rosea *Linn.* | 'Cultivated and sometimes as wild.' | Very common in waste places on Ross Island, and about Aberdeen. |
| | Plumeria acutifolia *Poir.* | 'Cultivated only.' | A very favourite shrub in all the European gardens. |
| | Nerium odorum *Sol.* | 'Cultivated only.' | |
| | *Heliotropium peruvianum *Linn.* | 'Cultivated only.' | |
| | Ipomœa Bona-nox *Linn.* | 'Cultivated only in gardens of Europeans.' | |
| 75 | I. Quamoclit *Linn.* | 'Cultivated in gardens, and now occurring as wild on Ross Island.' | |
| | I. Batatas *Lamk.* | 'Cultivated only.' | The Sweet-potato is rather largely cultivated in the Settlement. |
| | Lycopersicum esculentum *Mill.* | 'Much cultivated by native convicts.' | |

| | Name of Species. | Remarks. | |
|---|---|---|---|
| | | Condition in 1866 (*Kurz*). | Condition in 1889-90. |
| | Solanum Melongena *Linn.* | 'Much cultivated in native gardens and occasionally as wild.' | Often in waste places along with *S. indicum* and *S. ferox*; less often with *S. torvum.* |
| 80 | Capsicum, several species. | 'In cultivation by native convicts.' | Both the Chillee (*C. frutescens*) and the Bird's-eye Chillee (*C. minimum*) are much cultivated and the latter—the one with small elongated erect berries—is now a frequent weed in waste places. The Big Chillee (*C. grossum*) with large round red berries is very little grown. |
| | Datura, species. | 'Cultivated in gardens.' | There was no *Datura* in cultivation, so far as I could see, but *D. fastuosa* Linn. is now a common weed on rubbish-heaps and in waste places. |
| | Nicotiana Tabacum *Linn.* | 'Cultivated on Mt. Harriet, etc.' | Systematically cultivated as one of the industries of the Settlement. |
| | *Petunia violacea *Linn.* | 'Cultivated in gardens.' | |
| 85 | *Russelia juncea *Zucc.* | 'Cultivated in gardens.' | |
| | Justicia Gendarussa *Linn. f.* | 'Cultivated in gardens.' | |
| | Graptophyllum hortense *Nees.* | 'As the former.' | |
| | Lantâna camara *Linn.* | 'About Aberdeen, amongst the shrubberies as wild but rare.' | Common at Aberdeen and also on Ross Island where it is planted and trimmed *into a hedge!* |
| | Stachytarpheta indica *Vahl.* | 'Cultivated in gardens, at present covering all the sides of Ross Island and around Aberdeen.' | Now also in many places on the opposite side of the harbour, as at Hopetown, Mitakari, etc., but never in gardens, either native or European. |
| 90 | *Verbena Aubletia *Linn.* and other species. | 'Cultivated in gardens.' | |
| | Duranta Plumieri *Jacq.* | 'Cultivated in gardens.' | |
| | Vitex trifolia *Linn.* | 'Only cultivated in gardens.' | Cultivated, but much more often quite spontaneous. |
| | Ocimum sanctum *Linn.* | 'Cultivated lands at Ross Island, introduced.' | Also in gardens, both of Europeans and natives, though very frequent in waste places all over the Settlement. |

| | Names of Species. | Remarks. | |
|---|---|---|---|
| | | Condition in 1866 (*Kurz*). | Condition in 1889-90. |
| | *Salvia coccinea *Linn.* and other species. | 'Cultivated in gardens of Europeans.' | |
| 95 | Plantago major *Linn.* | 'Cultivated in native gardens.' | Not seen in 1889 or 1890. |
| | Mirabilis Jalapa *Linn.* | 'Only cultivated in gardens.' | Now not infrequently spontaneous. |
| | Celosia cristata *Linn.* | 'Cultivated in gardens.' | |
| | Amarantus, several species. | 'Cultivated in native gardens.' | *A. paniculatus* and *A. caudatus.* |
| | Gomphrena globosa *Linn.* | 'Cultivated and sometimes as wild.' | |
| 100 | Piper Betle *Linn.* | 'Cultivated by convicts.' | |
| | *Euphorbia pulcherrima *Willd.* | 'In gardens, cultivated.' | |
| | Jatropha multifida *Linn.* | 'Cultivated only.' | |
| | Jatropha purgans *Linn.* | 'Cultivated only.' | |
| | Ricinus communis *Linn.* | 'Cultivated only.' | Cultivated but also spontaneous on all rubbish heaps and in every waste place and by roadsides. |
| 105 | Cannabis sativa *Linn.* | 'Cultivated only.' | |
| | Artocarpus integrifolia *Linn.* | 'Cultivated only.' | |
| | Casuarina equisetifolia *Forst.* | 'At Ross Island, cultivated' | Also now extensively planted on Mt. Harriet and many seedlings appearing. This species is, however, *indigenous* in the Andamans; Col. Cadell, V. C., Chief Commissioner, tells me it is plentiful at Casuarina Bay on the west side of N. Andaman. |
| | Curcuma, several species. | 'Cultivated.' | |
| | Canna indica *Linn.* | 'Cultivated in gardens and sometimes wild in jungles, where it has been sown.' | |
| 110 | Musa sapientum *Linn.* | 'Cultivated everywhere.' | |
| | Ananas sativa *Adans.* | 'Now everywhere cultivated and producing fruit of good quality.' | |
| | *Belamcanda sinensis *Adans.* | 'In gardens; cultivated.' | |
| | *Zephyranthes, species. | 'Cultivated in gardens.' | |
| | *Hippeastrum, species. | [Cultivated in gardens']. | |

| Names of Species. | Remarks. | |
|---|---|---|
| | Condition in 1866 (*Kurz*). | Condition in 1889-90. |
| 115 *Allium sativum *Linn* | 'Cultivated in gardens.' | |
| *A. Cepa *Linn.* | [Cultivated in gardens]. | |
| Areca Catechu *Linn.* | 'Cultivated, especially at Aberdeen.' | Extensively cultivated. |
| Cocos nucifera *Linn.* | 'Only on the Cocos islands indigenous. Now everywhere cultivated and sown along the shores.' | Very extensively planted throughout the Settlement, many thousands of trees of excellent quality having been planted in the ground reclaimed from mangrove swamps. The quality of the cocoanut produced by the trees on Great Coco Island is comparatively poor. The question of distribution of this species is hoped to be discussed in a future note. |
| Panicum jumentorum *Pers.* | 'Cultivated at Ross Island and Aberdeen.' | |
| Coix Lachryma *Linn.* | 'Cultivated in gardens.' | Now in ditches as if wild at Aberdeen and Haddo. |
| 120 Zea Mays *Linn.* | 'Cultivated in gardens and sometimes as wild.' | Cultivated largely; not seen anywhere as if spontaneous. |
| Oryzas ativa *Linn.* | 'Only in small quantities; cultivated.' | Now a staple crop; along with maize in new forest clearings, then rather unsuccessfully, *especially during the first season*, on account of an insect-pest; also very largely cultivated in the reclaimed mangrove-swamp land, there producing heavy crops of excellent quality. |
| Saccharum officinarum *Linn.* | 'Cultivated by convicts.' | |
| 123 Cynodon Dactylon *Pers.* | 'The favourite grass here; everywhere sown and now occurring wild on the cleared lands.' | Very common everywhere, and still the favourite grass. |

II. *Species cultivated or planted, or obviously introduced, seen in* 1889 *and* 1890 *not present in* 1866.

| | Names of Species. | Remarks. |
|---|---|---|
| | Anona reticulata *Linn.* | Cultivated. |
| 125 | Garcinia Mangostana *Linn.* | Cultivated and doing well. |
| | Camellia theifera *Griff.* | Systematically cultivated as one of the industries of the Settlement; the tea produced is of excellent quality. |
| | Hibiscus esculentus *Linn.* | Cultivated in gardens. |
| | H. Sabdariffa *Linn.* | Cultivated by convicts. |
| | Durio Zibethinus *DC.* | Cultivated. |
| 130 | Swietenia Mahogani *Linn.* | Planted. |
| | S. macrophylla *King.* | Planted and thriving well, does much better than the true mahogany. |
| | *Nephelium Litchi *Camb.* | Cultivated but with poor results. |
| | Phaseolus trilobus *Ait.* | Cultivated by convicts, but also very common in waste places as a weed. |
| | Bauhinia acuminata, *Linn.* | Cultivated, but also appearing spontaneously. (K.) |
| 135 | Poinciana regia *Boj.* | Planted. |
| | Brownea, several varieties. | Planted. |
| | Amherstia nobilis *Wall.* | Planted and thrives very well. |
| | Tamarindus indica *Linn.* | Planted. |
| | Saraca indica *Linn.* | Planted. |
| 140 | Pithecolobium dulce *Benth.* | Planted as a shade-tree and also trimmed as a hedge; many seedlings appearing spontaneously. |
| | P. Saman *Benth.* | Planted very generally; does well on roadsides and on ground too indiscriminately cleared—which few native species will.* |

* *Pithecolobium Saman*, the Rain-tree, a native of the West Indies, Central America, Venezuela and Guiana, though yielding a timber useless except as firewood is nevertheless a valuable tree. It is a fast-growing and easily-raised species and, if planted along with more valuable kinds, forms an effective nurse for these during the earlier years of their growth. It also yields a valuable crop of sweet pulpy pods greedily eaten by cattle. It is said, moreover, to improve the quality of land encrusted with *reh* inflorescence. The following girth measurements of 13 trees in the Botanic Garden, Calcutta, will give some idea of the rate at which the species grows. The measurements in every case are taken at 60 inches from the surface of the soil—the trees measured were not selected (except No. 13 which was added as being the largest in the whole line) but were contiguous trees in the road known as the *College avenue*. The trees all date from 1876; the measurements were made in January 1890.

| | ft. | in. | | ft. | in. |
|---|---|---|---|---|---|
| No. 1. | 5 | 5½ | No 8. | 5 | 1 |
| „ 2. | 6 | 4 | „ 9. | 5 | 4 |
| „ 3. | 6 | 4 | „ 10. | 6 | 7 |
| „ 4. | 5 | 7 | „ 11. | 7 | 3 |
| „ 5. | 7 | 5 | „ 12. | 5 | 11½ |
| „ 6. | 7 | 6 | „ 13. | 8 | 3 |
| „ 7. | 6 | 10⅛ | | | |
| | | | average girth | 6 | 5½ |

| | Names of Species. | Remarks. |
|---|---|---|
| | Melaleuca Leucadendron *Linn.* | Planted. |
| | Eugenia Jambos *Linn.* | Cultivated. |
| | *Daucus Carota *Linn.* | Cultivated. |
| 145 | Ixora coccinea *Linn.* | Very common in gardens of Europeans. |
| | *Coffea arabica *Linn.* | Cultivated. |
| | Carissa Carandas *Linn.* | Cultivated, not very successfully. |
| | Ipomœa coccinea *Linn.* | In gardens, but also a frequent escape. |
| | Solanum tuberosum *Linn.* | The potato does very poorly. |
| 150 | Physalis peruviana *Linn.* | Cultivated. |
| | Torenia, sp. | Cultivated, but also often appearing spontaneously. |
| | Thunbergia alata *Boj.* | Cultivated, but also appearing as an escape, *e. g.*, at Namuna ghat. (K.) |
| | T. erecta *T. And.* | Planted as a hedge on Mt. Harriet. |
| | Dædalacanthus salaccensis *T. And.* | Frequent in gardens. |
| 155 | Tectona grandis *Linn. f.* | The teak-plantations under the care of the Forest Department are doing exceedingly well.* |
| | Bougainvillea glabra *Choisy.* | In gardens of Europeans. |
| | Deeringia celosioides *Br.* | In gardens, but also appearing subspontaneously. |
| | Cinnamomum zeylanicum, *Breyn.* | Cultivated and doing very well. (K). |
| | Euphorbia antiquorum *Linn.* | Grown as a hedge-plant. |
| 160 | Ficus bengalensis *Linn.* | Planted. |
| | F. Rumphii *Blume.* | Largely planted on roadsides at Aberdeen under the impression that it was the Pípal (*F. religiosa*). |
| | F. religiosa *Linn.* | A few trees only. |
| | Ravenala madagascariensis *Adans.* | Planted. |
| | Agave vivipara *Linn.* | Very common in gardens of Europeans. |
| 165 | Dioscorea sativa *Linn.* | Cultivated. |
| | Colocasia antiquorum *Schott.* | Cultivated but also appearing spontaneously in marshy spots around Aberdeen. |
| | Bambusa Brandisii *Munro.* | These Bamboos have been planted somewhat extensively throughout the Settlement. |
| | Dendrocalamus strictus *Nees.* | |
| 169 | Cephalostachyum pergracile *Munro.* | |

These intentionally introduced species belong to three distinct classes :—

1. *Such as probably never could become naturalized*—truly exotic species, such as temperate vegetables and garden flowers and plants

The name Rain-tree is derived from a phenomenon of condensation or exudation (both explanations have been offered) *said to be exhibited by the tree in America* ; in India nothing of the sort occurs.

* It should be noted also that the Forest Department is actively engaged in propagating *Padouk*, a very valuable indigenous timber tree (*Pterocarpus indicus* Willd.) and that the Andamanese *Pyenmah*, another good timber tree (*Lagerstræmia hypoleuca* Kurz) is extensively planted.

that affect a drier climate than that of the Andamans; such species have been distinguished by an (*) :—

2. *Such as might be expected to hold their own in the struggle for existence* should the Settlement happen to be abandoned—a class the precise limits of which cannot be laid down with certainty; this is the class not marked (*) and at the same time not noted as occurring spontaneously; it is moreover from this that the next class is recruited;

3. *Such as are naturalized in the Andamans now*—the species for which there was evidence either in 1866 or 1890 that spontaneous appearance has actually commenced.

The two former classes do not require further consideration; taken in detail we find that of the last class 14 species were naturalized prior to 1866. These were :—

| | |
|---|---|
| *Impatiens Balsamina.* | *Lantana camara.* |
| *Clitoria Ternatea.* | *Stachytarpheta indica.* |
| *Cajanus indicus.* | *Ocimum sanctum.* |
| *Carica Papaya.* | *Gomphrena globosa.* |
| *Vinca rosea.* | *Canna indica.* |
| *Ipomœa Quamoclit.* | *Cocos nucifera.* |
| *Solanum Melongena.* | *Cynodon Dactylon.* |

Before 1889 14 other species, that had been introduced prior to 1866 but had not at that date become naturalised, had begun to appear spontaneously. These were :—

| | |
|---|---|
| *Bixa Orellana.* | *Capsicum minimum.* |
| *Gossypium barbadense.* | *Datura fastuosa.* |
| *Moringa pterygosperma.* | *Vitex trifolia.* |
| *Trichosanthes cucumerina.* | *Mirabilis Jalapa.* |
| *Luffa ægyptiaca.* | *Ricinus communis.* |
| *Zinnia elegans.* | *Casuaria equisetifolia.* |
| *Tagetes*, sp. | *Coix Lachryma.* |

At the same time 9 other species not present in the Andamans at all in 1866 were nevertheless appearing spontaneously in 1890. These were :—

| | |
|---|---|
| *Phaseolus trilobus.* | *Ipomœa coccinea.* |
| *Bauhinia acuminata.* | *Torenia*, sp. |
| *Pithecolobium dulce.* | *Thunbergia alata.* |
| *P. Saman.* | *Deeringia celosiodes.* |

*Colocasia antiquorum.*

So that in 1890 there were in the Andamans no fewer than 37 species occurring spontaneously that had originally been intentionally introduced, as against 14 species of this kind in 1866.

It is necessary to note further that one species, *Zea Mays*, which

Mr. Kurz found occurring spontaneously in 1866, was only seen cultivated in 1889 and 1890.

### B. Weeds or unintentionally introduced species.

### III. *Species unintentionally introduced prior to* 1866.

| | Name of Species. | Remarks. | |
|---|---|---|---|
| | | Condition in 1866 (*Kurz*). | Condition in 1889-90. |
| | Cleome viscosa *Linn.* | 'Cultivated lands, Ross Island, introduced and rare.' | Still rare. |
| | Saponaria Vaccaria *Linn.* | 'Cultivated lands near Aberdeen, introduced and rare.' | Not seen in 1889 or 1890. |
| | Portulaca oleracea *Linn.* | 'Cleared lands around Aberdeen, Haddo, on Ross Island, etc., introduced.' | Observed at Rangachang also, which is almost the extreme limit of the Settlement. |
| | Portulaca quadrifida *Linn.* | 'Cleared lands around Port Blair, introduced.' | Much more unusual than the preceding. |
| 5 | Sidacarpinifola *Linn.* | 'Cleared lands, Aberdeen, Ross Island, etc., introduced.' | Very common all over the Settlement. |
| | Oxalis corniculata *Linn.* | 'Cultivated lands around Port Blair, introduced and rare. | Still exceedingly uncommon; not seen on Ross Island. |
| | Cardiospermum Halicacabum *Linn.* | 'Cleared lands around Aberdeen, common but introduced.' | |
| | Desmodium triflorum *DC.* | 'Common in cleared lands around Port Blair, introduced.' | Very common on the drier grassy slopes all over the Settlement. |
| | Cassia alata *Linn.* | 'Hopetown, as wild, but evidently introduced.' | Very common near Hopetown, not seen elsewhere. |
| 10 | Mimosa pudica *Linn.* | 'Cleared lands around Aberdeen and Phoenix Bay, rare, introduced.' | Very common throughout the whole extent of the Settlement. |
| | Bryophyllum calycinum *Salisb.* | 'On Ross Island, in cultivated lands, rare, and evidently introduced.' | Not seen in 1889 or 1890. |
| | Ludwigia prostrata *Roxb.* | 'From Aberdeen to Haddo on wet places, appears to be introduced with rice.' The *L. parviflora* of Mr. Kurz's list. Both sp. are now common but Mr. Kurz only gathered this one. | Common in the rice fields reclaimed from mangrove swamps all over the Settlement. |
| | Mukia scabrella *Arn.* | 'Aberdeen, cultivated lands, rare, introduced.' | Not uncommon about the Settlement. |
| | Dentella repens *Forst.* | 'Cultivated lands on Ross Island, around Aberdeen, etc., introduced. | |

| | Name of Species. | Remarks. | |
|---|---|---|---|
| | | Condition in 1866 (*Kurz.*) | Condition in 1889-90. |
| 15 | Oldenlandia corymbosa *Linn.* | 'Cultivated lands around Port Blair, introduced.' | A very common species. |
| | Vernonia cinerea *Less.* | 'Common all over the cleared lands but only introduced.' | |
| | Elephantopus scaber *Linn.* | 'Ross island in cultivated lands, rare, introduced.' | Not seen in 1889 or 1890. |
| | Ageratum conyzoides *Linn.* | 'Common on cleared ground, rapidly penetrating into the jungles whenever a little cleared, introduced.' | |
| | Blumea amplectens *DC.* | 'Phœnix Bay, cleared lands, introduced.' | Common everywhere, but possibly indigenous. |
| 20 | Eclipta alba *Hassk.* | 'Common on cultivated or cleared lands around Port Blair, introduced.' | |
| | Synedrella nodiflora *Gaertn.* | 'Common on cleared lands around Hopetown and Aberdeen, introduced.' (*Blainvillea latifolia* Kurz, non DC.); 'cultivated lands, Ross Island, rare, introduced'; (*Spilanthes oleracea* Kurz, non Linn.). | Extremely common everywhere and in two strikingly distinct conditions; one, the genuine plant, and another, larger in habit and ranker of growth but smoother in all its parts, strikingly like *Blainvillea latifolia* at first sight. |
| | Centipeda orbicularis *Lour.* | 'Cultivated lands on Ross Island, around Aberdeen, etc., introduced.' | |
| | Heliotropium indicum *Linn.* | 'Cultivated lands around Aberdeen, rare and introduced.' | Not very common. |
| | Cynoglossum micranthum *Desf.* | 'Between Aberdeen and Phœnix Bay, I suspect introduced only, as I saw it nowhere else.' | Not seen in November, 1889 found in April, 1890. |
| 25 | Solanum nigrum *Linn.* | 'Cultivated lands around Aberdeen, rare, introduced.' | Very common. |
| | Solanum torvum *Sw.* | 'Around Aberdeen, etc.; introduced.' | Very common. |
| | Solanum xanthocarpum *Schrad.* | 'Cleared lands around Phœnix Bay and Aberdeen; introduced.' | Not at all common. |
| | Angelonia salicariaefolia *H. B. & K.* | 'Common in cultivated lands on Ross Island; introduced.' | Not common. |
| | Mazus rugosus *Lour.* | 'Cultivated lands around Aberdeen; introduced.' | |
| 30 | Vandellia crustacea *Benth.* | 'In cultivated lands around Port Blair; introduced.' | |
| | Bonnaya veronicæfolia *Benth.* | 'Cultivated lands around Aberdeen; introduced.' | |

| | Names of Species. | Remarks. | |
|---|---|---|---|
| | | Condition in 1866 (*Kurz.* | Condition in 1889-90. |
| | Scoparia dulcis *Linn.* | 'Common all over the cleared lands around Port Blair and penetrating into the jungles; introduced.' | |
| | Rungia parviflora *Nees* var. pectinata *Clarke.* | 'Andamans.' | On Ross Island, and evidently introduced, not common. |
| | Lippia nodiflora *Rich.* | 'Cleared lands all around Port Blair, and becoming very fleshy along the sea shores; introduced.' | |
| 35 | Leucas linifolia *Spreng.* | 'Cultivated lands, on Chatham Island; introduced and still rare.' | Not yet on the mainland or on Ross Island apparently. |
| | Celosia argentea *Linn.* | 'Cleared lands around Haddo; rare; introduced. | Still rare. |
| | Amarantus spinosus *Linn.* | 'Cultivated lands around Phœnix Bay; introduced and rare.' | Still rare. |
| | A. viridis *Linn.* | 'Rather common in cleared lands at Aberdeen, Ross Island, Haddo, etc.; introduced.' | Very common. |
| | Alternanthera sessilis *R. Br.* | 'Common in cleared lands along roads, etc., at Port Blair; introduced.' | Common. |
| 40 | Polygonum barbatum *Linn.* | 'Some shoots of species of this genus I observed in the cultivated lands around Haddo; evidently introduced.' | Common in the ditches about Aberdeen. |
| | Euphorbia pilulifera *Linn.* | 'Cultivated lands around Port Blair; common; introduced. | |
| | E. thymifolia *Burm.* | 'Along roads, in cultivated lands, etc., around Port Blair; introduced.' | |
| | Cyperus polystachyus *Rottb.* | 'Cultivated lands between Aberdeen and Navy Point; introduced.' | |
| | C. distans *Linn. fil.* | 'Ross Island and other stations, in pasture ground; introduced.' | |
| 45 | C. compressus *Linn.* | 'Cultivated lands here and there around Port Blair; introduced.' | |
| | C. Iria *Linn.* | 'Rather rare, in wet places at Ross Island, etc.; introduced.' | Not now very rare. |
| | Kyllinga monocephala *Rottb.* | 'Cleared lands around Port Blair; introduced.' | Common; both type and var. *subtriceps. K. triceps* of Kurz' list is only this latter variety. |

| | Names of Species. | Remarks. | |
|---|---|---|---|
| | | Condition in 1866 (*Kurz.*) | Condition in 1889-90. |
| | Fimbristylis diphylla *Vahl.* | 'Common all over the cleared lands around Port Blair; introduced.' The *F. miliacea* of Kurz' list is only another state of this species and is not *F. miliacea* of Vahl. | Perhaps indigenous. |
| | Paspalum filiculmum *Nees.* | 'On Ross Island; introduced.' | Common. |
| 50 | P. scrobiculatum *Linn.* | 'Cultivated lands around Port Blair; introduced. | |
| | Eriochloa annulata *Nees.* | 'On Ross Island; introduced.' | Also about Aberdeen. |
| | Panicum Colonum *Linn.* | 'South Point, Aberdeen, etc., in cultivated lands; introduced.' | |
| | P. ciliare *Retz.* | 'Common in cultivated lands around Port Blair; introduced.' | |
| | P. sanguinale *Linn.* | 'Cultivated lands around Port Blair; introduced.' | |
| 55 | Andropogon pseudo-ischæmum *Nees.* | 'Cultivated lands and gardens at Ross Island; introduced.' | |
| | A. contortum *Linn.* | 'Only in garden land on Ross Island; introduced.' | Common everywhere. |
| | Chrysopogon aciculatum *Trin.* | 'Common on Chatham Island; introduced.' | Common throughout the Settlement. |
| | Sporobolus diander *Trin.* | 'Common on Chatham Island; introduced.' | Very common throughout the Settlement. |
| | Eleusine indica *Gaertn.* | 'Cultivated lands everywhere around Port Blair; introduced.' | |
| 60 | E. aegyptiaca *Pers.* | 'Cultivated lands on Ross Island; introduced.' | Common every where around Port Blair. |
| 61 | Leptochloa filiformis *R. Br.* | 'Along the path from Phœnix Bay to Aberdeen; scarce; introduced.' | |

IV. *Species unintentionally introduced between* 1866 *and* 1890.

| | Name of Species. | Remarks. |
|---|---|---|
| | Sida rhombifolia *Linn.* | Everywhere throughout the Settlement and quite as common as *S. carpinifolia* is. |
| | Melochia corchorifolia *Linn.* | Occasional. |
| | Triumfetta rhomboidea *Jacq.* | On Ross Island, and also at Aberdeen, not yet very common. |
| 65 | Crotalaria retusa *Linn.* | Not infrequent about Aberdeen, not seen in cultivation. |

| | Names of Species. | Remarks. |
|---|---|---|
| | Smithia sensitiva *Linn.* | Common on dry grassy slopes at Aberdeen. |
| | Desmodium polycarpon *DC.* | Common at North Bay and on the cleared hill-sides above. Not met with by Mr. Kurz, but, perhaps, it may be indigenous for it also occurs on Great Coco Island and Barren Island. |
| | D. auricomum *Grah.* | Common along with *Smithia* and with *Desmodium triflorum*. It is rather an interesting addition to the Flora, for though a mere weed this plant has hitherto only been collected in Tenasserim, Martaban and Arracan. |
| | Alysicarpus vaginalis *DC.* | Common on grassy slopes (K.) |
| 70 | Cassia occidentalis *Linn.* | Common (K.). |
| | C. Tora *Linn.* | Very common everywhere. |
| | Ammannia baccifera *Linn.* | In wet places, not uncommon. |
| | Jussiæa suffruticosa *Lamk.* | In wet places, along with the two *Ludwigias* and much more plentiful than either. |
| | Ludwigia parviflora *Roxb.* | Common in ricefields, but not quite so frequent as *L. prostrata.* |
| 75 | Hydrocotyle asiatica *Linn.* | Common on stone walls and roadsides all over Ross Island, but not yet present on the mainland or on the other islands. |
| | Oldenlandia diffusa *Roxb.* | Aberdeen etc., not very common. |
| | O. crystallina *Linn.* | The commonest *Oldenlandia* on Ross Island. The commonest both at Aberdeen and on Mt. Harriet is *O. corymbosa.* |
| | O. paniculata *Linn.*; forma 'minima' = *Hedyotis minima* Burm. | Common on Ross Island and obtained both by the writer in 1889 and by Dr. King in 1890. |
| | Adenostemma viscosum *Forst.* | Only met with in one place on a rubbish heap Ross Island. |
| 80 | Blumea glomerata *DC.* | Common on Ross Island, etc., (K.). |
| | Wedelia calendulacea *Less.* | Ross Island only (K.) |
| | Cosmos sulphureus *Cav.* | Very common on hill sides and waste places. This the writer was assured had never been grown as a garden plant. It forms large patches where it occurs, the individual plants being 6 to 10 feet in height. |
| | Tridax procumbens *Linn.* | Common on Ross, not yet common on the mainland. |
| | Crepis japonica *Benth.* | Introduced at Aberdeen (K.). |
| 85 | Sonchus arvensis *Linn.* | Common in gravel pits on Mt. Harriet. |
| | Launea nudicaulis *Less.* | Both on Ross and at Aberdeen (K.). |
| | Ipomœa aquatica *Forsk.* | In ponds at Aberdeen; the mode of introduction of this species is open to question. It may have been introduced by birds, but it may equally well have been introduced as a weed. |
| | Solanum ferox *Linn.* | Very common all over the settlement on drier hill sides along with *S. torvum.* |
| | S. indicum *Linn.* | Quite as common as the preceding. [*S. nigrum* and *S. xanthocarpum*, though introduced before 1866, are by no means so frequent.] |
| 90 | Physalis minima *Linn.* | Not at all common. |
| | Striga lutea *Lour.* | Common on dry hill sides at Aberdeen, parasitic on introduced grasses. |
| | Sesamum indicum *DC.* | Frequent (K.). |

| | Names of Species. | Remarks. |
|---|---|---|
| | Phaylopsis parviflora *Willd.* | Rare, on Ross only (K.). |
| | Hygrophila quadrivalvis *Nees.* | Common in wet places along with *Jussiæa* and *Ludwigia.* |
| 95 | Lippia geminata *H. B. K.* | At Namuna ghat (K), rare. |
| | Hyptis brevipes *Poit.* | Common (K.). |
| | Bœrhaavia repens *Linn.* | Not common and not met with by Mr. Kurz; it may, however, be indigenous; it certainly seems to be so on Great Coco Island. |
| | Aerua lanata *Juss.* | Not very common. |
| | Achyranthes aspera *Linn.* | Very common in every part of the settlement and penetrating into the jungles. |
| 100 | Phyllanthus urinaria *Linn.* | Common on Ross and on Mt. Harriet; not so plentiful at Aberdeen. |
| | Monochoria vaginalis *Presl.* | In ponds at Aberdeen; perhaps introduced by means of wading-birds.* |
| | Paspalum distichum *Linn.* | Common on Ross and at Hopetown. |
| | P. pedicellatum *Nees.* | Common on Ross, not seen elsewhere. |
| | Panicum erucæforme *Sibth.* | Aberdeen, common. |
| 105 | P. excurrens *Trin.* | By edge of pond at Aberdeen. |
| | P. longipes *W. & A.* | On Mt. Harriet. |
| | P. myosuroides *R. Br.* | Very common. |
| | Imperata cylindrica *Kunth.* | Common everywhere. |
| | Rottbœllia exaltata *Linn.* | Common in marshy ground about Aberdeen and Haddo. |

* There is another species that has, however, been excluded from this list, because neither Dr. King in 1890 nor the writer in 1889 met with it, to which the same remark applies. This species is *Barclaya longifolia.* The Andamans is first given as a locality for this species in King: *Materials for a Flora of the Malayan Peninsula,* p. 34. The Andamans specimens were obtained by one of Dr. King's garden collectors in 1884 in a ditch among rice-fields near Haddo. It may be said with something like certainty that the species was not there in 1858; at all events there was no rice-field and no ditch then. And it is almost as certain that it was not present in 1866, for Mr. Kurz, as his *Report* shews, gave particular attention to aquatic vegetation, yet he did not meet with it. Probably the ditch where Dr. King's collector found *Barclaya,* like the pond where the writer found *Monochoria* and *Ceratopteris,* did not exist at all in 1886. Another circumstance that tends to confirm the idea of the introduction being recent is that it does not appear to be present in any of the ditches or ponds examined by the writer in 1889, and Dr. King, to whom this fact was particularly mentioned, and who looked for *Barclaya* with especial care in 1890, was equally unsuccessful in his search. It may, therefore, be safely presumed to be still quite local. For the appearance of *Barclaya,* as for that of *Monochoria,* bird-agency at once suggests itself; introduction by indirect human agency is not, however, precluded in either case. Allowing the mode of introduction to be a point altogether doubtful, there still remains an interesting fact—this species (like *Desmodium auricomum*) is one hitherto only known from the opposite shores of the Andaman Sea. And this fact weakens the evidence from other sources as to introduction; for it is the Burmese, and particularly the *Pegu-Tenasserim* element, that seems to predominate in the *indigenous* Andaman flora.

| | Names of Species. | Remarks. |
|---|---|---|
| 110 | Ischæmum rugosum *Nees.* | Aberdeen. |
| | I. ciliare *Retz.* | Aberdeen, rather common. |
| | Anthistiria scandens *Roxb.* | Aberdeen, very common. |
| | Chloris barbata *Sw.* | Ross Island and Aberdeen. |
| | Eragrostis unioloides *Nees.* | Very common on Ross Island, not seen at Aberdeen. |
| 115 Cryptogams. | Selaginella proniflora *Bak.* | Very plentiful everywhere on Ross, but not present either at Aberdeen, Hopetown or Viper. |
| | Cheilanthes tenuifolia *Sw.* | On gravelly roadsides at Aberdeen. |
| | Ceratopteris thalictroides *Brogn.* | In ponds at Aberdeen; possibly introduced by water-birds; (see note on *Monochoria vaginalis.*) |

Comparing the state of affairs in 1866 with that prevailing in 1890 we find that at the former date there were present in the Andamans 61 weeds of cultivation of which 58 were again met with, either in November 1889 or in April 1890. But too great weight should not be placed on the absence of any plant, since it is quite possible that in visits of such short duration as those of the writer and Dr. King species that are not very common might easily be overlooked.

In November 1889 and in April 1890, on the other hand, we find that not only were 58, or 95 °/₀, of the weeds of 1866, present, but that 56 others had found their way into the settlement during the interval between 1866 and 1890.

Briefly reviewed the results indicated by these four lists are :—

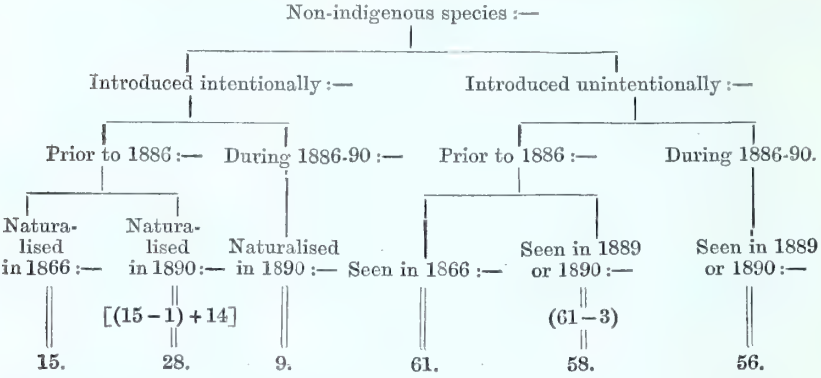
1. That in 1866 15 intentionally introduced plants and 61 weeds of cultivation had apparently or actually become so established in the Andamans that, though not indigenous plants, they had become an integral portion of the Andamans flora.

2. That by 1890 14 more of the plants intentionally introduced prior to, but only seen under cultivation in, 1866 had become similarly naturalised; that along with these 9 species, intentionally introduced during the interval between 1866 and 1890, had begun to appear spontaneously; also, that during the same interval 56 more weeds had been introduced.

3. That, on the other hand, a species appearing spontaneously in 1866 was only seen cultivated in 1890, and that three of the 1866 weeds were not met with in 1889 or 1890.

The subjoined table exhibits the intrusion of the non-indigenous element at present existing in the flora of the Andamans.

TABLE I. *Intrusion of non-indigenous Andamans plants.*




| | | |
|---|---|---|
| Total for 1866. | 15 + 61 | = 76. |
| Total for period 1866-90. | 14 + 9 + 56 | = 79. |
| Total for 1890. | 28 + 9 + 58 + 56 | = 151. |

During his stay in the Andamans in 1866 Mr. Kurz observed 520 indigenous species. But he has pointed out (*Report*, p. 19) that this "is only an approximation to the actual number existing on the is- "lands." Since 1866 the number of indigenous species has been raised to about 600. Mr. Kurz has recorded the number of species found growing on 100 square yards in a suitable locality in the interior on the eastern side of the island and not far from Aberdeen. He shews (*Report*, p. 21) that an estimate based on this record and extended to the rest of the islands of the Andaman group gives scarcely more than 600 or 700 species for the whole. At the same time, he thinks that an estimate of the same kind deduced from the conditions that prevail on the western side of the island would give quite other results, and, taking everything into consideration, he concludes that "the number of really "indigenous phænogamic plants may range between 1500 and 1800 "species." In all probability the second estimate is too high and perhaps a number nearer 1000 will be ultimately found to express the actual total of indigenous phanerogams. But the question need not be discussed here, and if in the meantime absolute records of the appearance of non-indigenous species be supplied, the precise proportion of introduced to indigenous species at various periods in the history of the islands can easily be ascertained when their flora shall have been completely investigated.

But a relative proportion is only less useful than an absolute one would be, and if we take 1000 as a convenient approximation to the actual total we may compare the state of affairs in 1866 with that in 1890. In this case we must confine ourselves to introduced phanerogams only, and exclude the three cryptogams that have been introduced during the interval between 1866 and 1890. The following are the results :—

1866. Proportion of introduced to indigenous species = $\frac{76}{1000}$ or, 1 : 13.

Percentage of introduced species = $\frac{76}{1076}$ or, 7·06%.

1890. Proportion of introduced to indigenous species = $\frac{146}{1000}$ or, 1 : 7.

„ Percentage of introduced species = $\frac{146}{1146}$ or, 12·74%.

The greater number of these introduced plants are herbaceous ; but the proportion of woody species is slowly increasing, as the following figures shew :—

1866. Proportion of woody to herbaceous species = $\frac{2}{74}$ or, 1 : 37.

„ Percentage of woody species = $\frac{2}{76}$ or, 2·63%.

1890. Proportion of woody to herbaceous species = $\frac{7}{139}$ or, 1 : 20.

„ Percentage of woody species = $\frac{7}{146}$ or, 4·79%.

Human agency is responsible for the introduction of the whole of this non-indigenous element in the Flora of the Andamans. That it is directly responsible for the introduction of such species as have been intentionally introduced that have subsequently become spontaneous is self-evident ; that it is equally directly responsible for the unintentionally introduced weeds is hardly less plain. They are with very few exceptions the commonest of Indian road-side and rice-field weeds whose seeds would readily be found mixed with imported grain or attached to the belongings of convict immigrants or of the police sepoys of the Settlement. This mode of introduction explains not only the occurrence of the weeds of dry ground but of the majority of the marsh species, such as *Hygrophila*, *Jussiæa*, *Ludwigia*, as well. And species of the only class for which this explanation is not altogether satisfactory—water-plants like *Monochoria*, *Ceratopteris*, or *Ipomœa aquatica*—nevertheless owe their introduction *indirectly* to human agency,

since but for the existence of the Settlement the ditches and pools in which they occur would not exist. The agency of winds, so often supposed to be highly effective, suggests itself for very few of the species, the most probable being the *Selaginella* and the *Cheilanthes*,—almost the only posssible one among phanerogams being the *Calotropis*. But if these be wind-introduced species then as regards all three the questions at once arise ;—why were they not to be found in 1866 ? and, why are they only to be found within the limits of the Settlement now ? And as regards *Selaginella* a closer enquiry makes the agency of wind highly improbable, for it is as yet only to be found on Ross Island, although there, as it happens, it is exceedingly common. Now Ross Island is the part of the Settlement that is in *immediate* intercourse with Burma and India, and unless it has been imported as a weed one can hardly explain its absence from the rest of the Settlement where the conditions are quite as favourable for its existence as they are on Ross. As regards *Calotropis* too there is a striking fact to record. It happens to be the chief food-plant of a particular species of butterfly—*Danais genutia*—which is dispersed throughout India and Burma. This butterfly was long supposed to be absent from the Andamans, but within the past few years it has been sparingly reported thence.* It thus seems as if till the establishment of its food-plant in the Settlement this butterfly was not known from the Andamans. To what agency the introduction of *Danais genutia* itself is due it is foreign to the purpose of this paper to enquire, but it is a suggestive fact that once the food-plant had become established the butterfly appeared. And the absence of the butterfly while there was no evidence of the presence of the plant seems presumptive evidence that the plant was *not* present till very recently, and that, therefore, human agency is not merely indirectly responsible for its introduction, by providing conditions suitable for the survival of wind-conveyed seeds, but is directly responsible, from the unintentional conveyance of its seeds along with grain or in some other way. For it is long since these suitable conditions have come into existence, and wind-agency, if a factor at all, is in these latitudes a fairly constant one.

Human agency being so completely responsible, one might hope that the channels of introduction of particular species, which must coincide with the routes of traffic between the Settlement and the adjacent mainland, could be easily ascertained. But this is far from being the case. These traffic routes are :—

* This information was offered by Mr. L. de Nicéville in the course of a brief conversation that followed the reading of this paper at the meeting of the Asiatic Society of Bengal in April 1890.

1. Calcutta to Port Blair; implying introduction from Northern India and especially the Gangetic plain.

2. Port Blair to Rangoon; implying introduction from Lower Burma.

3. Port Blair to Madras; implying introduction from Southern India.

4. Moulmein to Port Blair; implying introduction from Tenasserim—a route used by native craft.

5. Port Blair to the Nicobar Islands; implying introduction from these—the Nicobars are a dependency of the Settlement at Port Blair.

The distribution of the majority of these introduced species is so wide that (with the exception of 4 species whose introduction has almost certainly been confined to the Rangoon or the Moulmein route and other 4 almost certainly restricted to the Madras or the Calcutta route) any one of them may have equally well reached the Settlement by any or all of these routes. This is best shewn by a tabular view of the species thus introduced.

TABLE II. *Distributional features of the Non-indigenous element in the Flora of the Andamans.*

| | | |
|---|---|---|
| Cosmopolitan in the Tropics | | 62 |
| Indigenous in the Old World | | 65 |
| In other continents besides Asia | | 36 |
| Confined to Asia | | 29 |
| Throughout South-Eastern Asia | 21 | |
| Confined to India or only extending westward from India | 4 | |
| Confined to Burma and Malaya or only extending eastward thence | 4 | |
| Indigenous in the New World, but now cosmopolitam or nearly so | | 19 |

It may therefore be concluded that there is a practical indifference displayed as regards route; here, as everywhere else, when man is engaged in cultivation he involuntarily introduces weeds, and here as elsewhere a certain proportion of the species introduced by him for economic or for aesthetic reasons escape and become spontaneous.

It has been already said that the present Settlement occupies the site of an earlier one. This earlier settlement was founded under the

name of Port Cornwallis by Lieut. Blair* in 1789, in obedience to orders issued in September of that year. In November 1792 orders were issued for the removal of the Settlement to another and more spacious harbour in North Andaman; to this new settlement the original name Port Cornwallis was again applied. It is nowhere distinctly stated, though, considering the transfer of name from the old settlement to the new, it is highly probable, that *old* Port Cornwallis was entirely abandoned in 1792. We know, however, that in 1796 orders were issued for the removal of the whole establishment to Penang. The doubtful point, so far as our present enquiry is concerned, is the length of time prior to the establishment of the present Settlement that its site was exposed to influences favourable for the active introduction of non-indigenous species. But we know that altogether these influences only existed for six seasons and could only have been active during three seasons; probably they only existed at all during these three seasons. The present Settlement was commenced in March 1858; Mr. Kurz visited it during April-July 1866; to the eight seasons (1858-66) that had passed between the foundation of the Settlement and the date of that visit we must therefore add three more seasons (1789-92) in order to make up the whole period during which the non-indigenous species recorded by Mr. Kurz were being introduced. Even if the original site was not wholly abandoned in 1792 the subsequent seasons (1792-96) may be neglected without producing any appreciable error. Assuming, therefore, that a period of eleven seasons has been responsible for the naturalisation and introduction of the species in the two lists for 1866 we are able to calculate the rates of these processes and to compare them with the rates between 1866 and 1890. These are shewn in the following table:—

TABLE III.—*Rate of Introduction of Non-indigenous Species.*

| Non-indigenous species naturalised. | DURING PERIOD I. Prior to 1866 (1789-92 + 1858-66) = 11 seasons. | | DURING PERIOD II. Bet. 1866 & 1890, (1866-90) = 24 seasons. | |
|---|---|---|---|---|
| | No. of species. | Rate per annum. | No. of species. | Rate per annum. |
| Cultivated plants introduced during Period I ... ... | 15 | 1·36 | 14 | 0·58 |
| Cultivated plants introduced during Period II ... | ... | ... | 9 | 0·37 |
| Weeds of cultivation ... | 61 | 5·54 | 56 | 2·33 |
| Totals ... | 76 | 6·90 | 79 | 3·28 |

* The name of the 1789 Settlement having been transferred to the one founded in 1792, the present Settlement, which occupies the site of the 1789 one and which dates from March 1858, has been named PORT BLAIR in honour of the original founder. The name *Port Cornwallis* is still used to designate the *site* of the Settlement in North Andaman that existed from 1792 to 1796.

The rate per annum for the second period requires a slight correction by the deduction from it of the rate per annum of disappearance of naturalised species. We have seen that one introduced plant occurring spontaneously in 1866 was only under cultivation in 1889 and 1890 and that three of the 1866 weeds were not met with in 1889 or 1890. These 4 species, therefore, give a disappearance rate of $\frac{4}{24}=\frac{1}{6}$, or 0·16 species per annum, and the corrected rate for Period II is thus 3·28−0·16, or 3·12 species per annum.

When we find on comparing the two periods that the rate of introduction in the second is only 3·12 species, as compared with 6·90 in the first, we naturally endeavour to find some explanation of the discrepancy. But, unfortunately, no very satisfactory explanation offers itself. So far as cultivated species are concerned, we are not in a position to compare the 15 naturalised species of 1866 with the 23 similar species of 1890, but only with those 9 species that had been both introduced and naturalised subsequent to 1866. The proportions indicated by these two classes being 1·36 : 0·37 evidences a rate of naturalisation per annum $3\frac{1}{2}$ times as great for the earlier as for the later period. But when the circumstances of the case are considered we are not surprised that the difference should be so great; we are, rather, astonished at its being so small. Owing to the abandonment of the 1789 Settlement the species that had been introduced while it existed were left to their fate, and it would be no more than reasonable to expect that when the new Settlement was founded in 1858, and when Mr. Kurz visited it in 1866, the majority of the common tropical cultivated species had already become fairly naturalised. So far, however, was this from being the case that we find there were in 1866 only 15 such species naturalised, and we are compelled to conclude either, that the original settlement was very ill provided for, or that the species which on *a priori* grounds we might consider likely to hold their own in the struggle for existence in an abandoned settlement are really far from being able to do so. Now not only is there no ground for supposing that the Settlement was ill-provided for, but there is ample proof, from the evidence that exists of a direct and extensive reciprocal correspondence between its founders and the first Superintendent of the recently established Hon'ble Company's Botanic Garden at Calcutta, that the number of species introduced at Port Cornwallis was, for a Settlement so young, unusually high. We are compelled, therefore, to accept the other explanation and to conclude that cultivated species are not as a rule able to exist when they have to struggle on equal terms with a native jungle. Without mentioning other instances, we may refer to the lists of *Cucurbitaceæ* and *Leguminosæ* present in 1866 *as cultivated plants only*, yet in 1890 beginning to occur

spontaneously and appearing likely as time goes on to increase perceptibly the numbers of the non-indigenous flora. The greater number of these must have certainly been introduced in the 1789-92 period, and many of them are such as at first sight suggest for themselves the possibility of survival.

Perhaps, however, it ought not to surprise us greatly that species which readily appear spontaneously elsewhere and which are appearing spontaneously in the Andamans now, should, if they were previously introduced, have perished between 1792 and 1858. Most of them are plants that, when they do escape from cultivation and appear spontaneously, affect such situations as waste places, rubbish heaps, road-sides, hedge-rows and margins of clearings,—situations that have at least this in common, that they afford their denizens abundance of air and light. Many of them too are herbaceous, or at most fruticose, and the native jungle as it reinvades the abandoned clearings overshadows them and either chokes them completely, or by merely preventing them from flowering, makes their fate only a matter of time. Even trees that seem quite naturalised in clearings must soon succumb to the weight of creepers that rapidly overload them in a forest.

If, however, the survival of even a small proportion of the cultivated species abandoned in 1792 will suffice to explain the higher rate of naturalisation during Period I, deducible from the figures in Table III (*Carica Papaya* and *Cocos nucifera* are excellent examples of such survival), there is no similar explanation possible for the higher rate of weed-introduction during the same period. A considerable number must have been already introduced by 1792, and, though many doubtless yielded to the influences adverse for naturalised cultivated species, weeds are often proverbially tenacious of life and a good few, as the notes against them show, in place of avoiding the jungle are actually penetrating into it. Taken altogether we find that the rate of introduction during the first period was $2\frac{1}{3}$ times as high as it has been during the second, and the most probable explanation of this higher early rate of weed introduction appears to be that in the dirty grain of an Indian bazaar seeds of most of the commoner Indian weeds are certain to be present. This being the case so many weeds become introduced with the very earliest sowings of any grain that the subsequent rate of introduction of species can be but small. And it is highly probable that for the same reason the rate of weed-introduction becomes year by year diminished. Unfortunately it has not occurred to any one to make observations on these weeds during the interval 1858-66 or 1866-90. And without repeated observations after short intervals of time, especially towards the commencement of a settlement, it is impossible to test the adequacy of this explanation.

But it is not improbable that by the close of another period equal in length to the second the annual fall in the rate of introduction and, indeed, the annual rate of introduction itself will have become very small.

There is not likely to be the same falling off in the rate of naturalisation of intentionally introduced species. For, as the Settlement extends, localities suitable for the spontaneous appearance of already introduced species become year by year more numerous and at the same time the number of species capable of naturalisation becomes increased.

We find on briefly reviewing the results of our enquiry :—

1. That the total number both of naturalised and of unintentionally introduced species constantly increases.

2. That the rate of naturalisation of intentionally introduced species has hitherto been lower than the rate of introduction of unintentionally introduced species.

3. That in both cases the rate has been lower for the second period (1866-90) than for the first (prior to 1866).

4. That this lower rate for the second period is more apparent than real, and is probably due as regards naturalised species to the survival of some cultivated species left to their fate when the early Settlement (1789-92) was abandoned, and as regards weeds to the fact that the greater number of common Indian weeds are necessarily introduced with the earliest sowings of grain.

5. That in both cases the rate has now probably become nearly uniform, but that while for naturalised species it is steady or even uniformly increasing, for weeds it is probably uniformly decreasing.

The first three conclusions are borne out by the facts contained in the lists of species : the fourth is an expression of opinion, which it is unfortunately now impossible either to endorse or to refute as regards the Andamans ; it is, however, a question worthy of attention during the initial stages of any subsequent similar settlement : the last it will be easy for some future student of the subject to finally dispose of.

In concluding, the writer wishes to express his great obligations to Col. Cadell, V. C , Chief Commissioner of the Andamans, but for whose kind assistance it would have been impossible to collect so many species during his short stay at Port Blair ; also to Dr. G. King, F. R. S., C. I. E., for his kindness in supplementing the collection of 1889 with many specimens collected in April 1890.